

Space Evaporator Absorber Radiator (SEAR) for Thermal Storage on Manned Spacecraft

Abstract submitted for the 45th International Conference on Environmental Systems

Session: ICES103: Thermal and Environmental Control of Exploration Vehicles and Surface Habitats (?)
ICES501: Life Support Systems Engineering and Analysis (?)
Any thoughts on the most appropriate session?

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Future manned exploration spacecraft will need to operate in challenging thermal environments. State-of-the-art technology for active thermal control relies on sublimating water ice and venting the vapor overboard in very hot environments. This approach can lead to large loss of water and a significant mass penalty for the spacecraft. This paper describes an innovative thermal control system that uses a Space Evaporator Absorber Radiator (SEAR) to control spacecraft temperatures in highly variable environments without venting water. SEAR uses heat pumping and energy storage by LiCl/water absorption to enable effective cooling during hot periods and regeneration during cool periods. The LiCl absorber technology has the potential to absorb over 800 kJ per kg of system mass, compared to phase change heat sink systems that typically achieve ~50 kJ/kg. The optimal system is based on a trade-off between the mass of water saved and extra power needed to regenerate the LiCl absorber. This paper describes analysis models and the predicted performance and optimize the size of the SEAR system, estimated size and mass of key components, and power requirements for regeneration. We also present a concept design for an ISS test package to demonstrate operation of a subscale system in zero gravity.